

***What is claimed is:***

**CLAIMS**

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1. A process for cleaning semiconductor fabrication equipment parts comprising:

determining a definition for a clean part including multiple maximum  
10 acceptable impurity levels;

determining an initial multiple impurity levels of a part prior to its cleaning;

determining a cleaning process to apply to the part;

applying the cleaning process to the part, wherein the cleaning process creates reduced multiple impurity levels for the part below that of said initial multiple  
15 impurity levels;

determining said reduced multiple impurity levels;

comparing said reduced multiple impurity levels against said multiple maximum acceptable impurities levels of said definition; and

repeating the application of said cleaning process to said part if said reduced  
20 multiple impurity levels do not meet said definition of a clean part.

2. A process as recited in claim 1, further comprising testing the part in reassembled equipment in which the part was designed to operate.

25 3. A process as recited in claim 2, further comprising the operation of repeating a cleaning process on the part if the part does not function properly in the reassembled equipment.

4. A process as recited in claim 1, wherein at least one impurity level is determined utilizing a surface particle test.

5. A process of claim 1, wherein at least one impurity level is determined using a liquid particle test.

6. A process of claim 1, wherein at least one impurity level is determined by using acid-extraction ICP-MS.

10 7. A dilute aqueous cleaning solution for parts comprising:

0.5 – 1.5%wt. HF;

0.1-0.5%wt. HNO<sub>3</sub>; and

1-10%wt H<sub>2</sub>O<sub>2</sub>.

15 8. A dilute aqueous cleaning solution as recited in claim 7 wherein the concentration of H<sub>2</sub>O<sub>2</sub> is no greater than about 5%wt.

9. A method for reducing sub-surface damage to a part comprising:

determining how deep is the sub-surface damage beneath a surface of a part;

20 chemically etching said surface of said part; and

stopping said chemical etching of said surface at about said depth of said sub-surface damage.

10. A method for cleaning a part comprising:

performing an ultrasonication cleaning process to a surface of a part to be cleaned;

spray rinsing said part with a dilute chemical mixture; and

5 spray rinsing said part with deionized water.

11. A method for cleaning a part as recited in claim 10 further comprising repeating said spray rinsing of said part with a dilute chemical mixture and spray rinsing said part with deionized water based upon the specification of purity for said  
10 part.

12. A method for determining contamination of an openable part having inner surfaces comprising:

introducing a part into a controlled clean environment of at least class 1000;

15 opening said part in said controlled clean environment; and

running contamination analysis on said inner surfaces of said part.

13. A method for determining contamination as recited in claim 12 where running contamination analysis includes applying a known volume of ultra pure water  
20 to a cavity of a part, extracting said water, and analyzing contaminants found in said water.

14. A method for determining contamination as recited in claim 12 where running contamination analysis includes applying a known volume of a high purity

extraction solution to a cavity of a part, extracting said extraction solution, and analyzing contaminants found in said extraction solution.

5        15. A method for cleaning ceramic parts comprising:

      immersing a ceramic part into a first chemical bath to damage contaminant bonds;

      heating said ceramic part in a furnace after said contaminant bonds are damaged; and

10      immersing said ceramic part in a second chemical bath to remove contaminants.

15      16. A method for cleaning ceramic parts as recited in claim 15 wherein said first chemical bath is a dilute chemical bath including HF and HNO<sub>3</sub> which is heated to about 60-80°C.

17. A method for cleaning textured quartz parts comprising:

      immersing a textured quartz part into an ultrasonic chemical bath;

      immersing said textured quartz part into an ultrasonication water bath ; and

20      immersing said textured quartz part into a deionized water bath.

18. A method for cleaning metallic impurities from textured ceramic surfaces comprising:

immersing a ceramic part having a textured surface into a heated chemical bath;

rinsing said ceramic part in deionized water;

immersing said part in a dilute acid bath and rinsing;

5 visually inspecting said part; and

repeatedly immersing said part in said dilute acid bath until it passes visual inspection.

19. A method for cleaning metallic impurities as recited in claim 18  
10 further comprising:

immersing said part in an ultrasonification overflowing bath.

20. A method for determining the cleanliness of semiconductor fabrication equipment parts comprising:

15 testing the parts before a cleaning process for at least one of particles, metallic impurities and organics;

testing the parts after certain steps in the cleaning process for at least one of particles, metallic impurities and organics; and

20 testing the parts after a final cleaning step for at least one of particles, metallic impurities and organics.

21. A method for removing particles on a textured surface of a semiconductor fabrication equipment part comprising:

determining a chemical bonding characteristic of the particles;

identifying a type of particles embedded in the textured surface;

measuring a depth of any subsurface damage; and

performing a combination of ultrasonication and chemical etching to the  
textured surface based upon said chemical bonding characteristics, said type of  
5 particles and said depth of subsurface damage.

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